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THE BIOLOGY OF SOME DIPTEROUS GALL-MAKERS FROM TEXAS*

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Introduction

The life histories which follow represent a part time study extending over a period of about three years. An effort was made to collect as many as possible of the dipterous galls of the region about Austin, Texas, rear the makers, and note any information of interest concerning each. Unless otherwise specified the data given refers to galls collected near this city. The region mentioned is admirably located for all kinds of insect collecting. Since it is near the meeting place of several distinct kinds of plant associations; the variety of both flora and fauna is considerable.

A total of 124 types of galls were collected; and adult flies were reared from thirty-eight. One species of **Trypetidae** was reared; the remainder were **Itonididae.** From three galls, inquilines or unidentifiable adults were reared. Nine galls represent duplicates, that is, cases where the adult makes galls on two species of plants, or on different parts of the same plant. Of the twenty-five species or Itonididae reared, twelve or almost half, represent new species which are described by Doctor Felt in a preceeding paper (13). Of the remaining eighty-seven galls two contained Cyclorrhapha pupae, the others were made by Itonididae. A list of the species of plants, and the number of kinds of Dipterous galls collected on them, but not reared, is given below. (Table I)

Itonididae are frequently difficult to rear and several methods were used. After a gall was found on a plant, specimens were examined at intervals to determine the maturity of the occupants. When the insects were in the pupal or late larval stage the galls were brought in for

*The material in this paper was presented as a thesis in partial fulfillment of the requirements for Master of Arts degree at the University of Texas. The writer is indebted to Dr. J. T. Patterson, Department of Zoology and Dr. B. C. Tharp, Department of Botany at Texas University for help during the course of the investigation. The Acalypterae reared were identified by Mr. E. T. Cresson, Jr. of the Philadelphia Academy of Sciences. The Itonididae were identified by Dr. E. P. Felt, Bartlett Tree Research Laboratories, Stamford, Conn.

rearing. The most successful method was to confine the galls in lamp chimneys, on screen wire, over moist sand. This keeps the gall soft until the adults emerge. The only difficulty is that caused by fungi, but this usually does not prevent the emergence of the adults. In this way, an attempt was made to keep over winter certain galls that come out the following spring. A few insects lived through and emerged, but most of them did not. Rearing would be more probable if these galls were caged late in February.

Two fairly distinct types of life histories were noted; one type, represented by the galls on the hackberries, lasts throughout the year as a single generation; the other, generally found on annual plants, consists of one or more generations of short duration. In those with a single generation, the insects probably pass the winter in the gall. In those with several generations this may or may not be true.

Two general types of galls exist but there are others which represent intermediates. One type, (Pl. 1, fig. 8; pl. 2, fig. 5) similar to that of the Cynipidae, is a specialized structure unlike the surrounding plant tissue. The other (Pl. 2, fig. 1, Pl. 1, fig. 16, 17) is a simple swelling about the developing larvae. Galls are to be found on all parts of the plant but no root galls were collected. Of the plant species infested, the oaks, hackberries and the cedars yielded the most galls. Even within single species of plants there are distinct individual differences in degree of infestation. One tree will be practically free of galls; another of the same species standing next to it will bear a considerable variety of galls, often in great numbers. One of the most interesting galls collected but not reared was on the parasitic vine, the "Dodder", (**Cuscuta arvensis** Beyrich).

Both parasites and inquilines were reared. The former were less abundant on the annual plants; but the number varies greatly among the different insect species.

Among several species evidence was found of an alternation of distinct gall types on the same plant produced by the same insect species. One of these is typical of the spring and summer generations, the other of the winter one. An example is found in **Asphondylia prosopidis** Ckll. It has been known for some time that an Itonidid species may produce several kinds of galls, but there does not appear to have been evidence of an alternation of types correlated with the seasons. This may be due to response of either insect or plant.

TABLE I
Summary of Dipterous Galls Collected But Not Reared

Species of Plant	Total number of galls.	Species of Plant	Total number of galls.
Taxodium		Geoprumnon mexicana	1
—distichum	2	Meibomia lindheimeri	1
Sabina		Sophora secundiflora	1
—sabinoides (1)	2	Polygala lindheimeri	1
—virginiana	1	Acalypha ostryaefolia	1
—sabinoides & virginiana	1	Tagea	
Hicoria		—nepetaefolia	1
—glabra	4	—urticaefolia	1
Quercus		Schmaltzia trilobata	1
—breviloba	2	Vitis	
—marilandica	7	—candicans	3
—stellata	2	—cordifolia	1
—schneckii	2	Callirrhoe digitata	1
—virginiana	1	Svida asperfolia	1
—muehlenbergii	2	Bumelia languinosa	1
—marilandica & schneckii	4	Cuscuta arvense(2)	1
Celtis		Solanum elaeagnifolium	1
—mississippiensis	12	Verbena neo-mexicana	1
—reticulata	2	Coleosanthus cylindraceus	1
—mississippiensis & reticulata	4	Aster azureus	1
Clematis drummondii	2	Leptilon canadense	1
Vorna simsii	1	Verbesina virginica	3
Berberis trifoliolata	1	Viguera helianthoides	2
		Bussingaultia	1
Total		87	

Notes

(1). A number of other galls on this genus noted but not recorded.
(2). Collected at Brownwood; a weevil gall found on this at Austin.

Adults reared from several galls were in too poor condition for identification; or were inquiline. One of these was a stem gall on **Baccharis angustifolia** Michx. from which an **Asphondylia** was reared March 23. A female that is probably **Rhopalomyia salviae** Felt was reared from a flower bud gall on **Salvia lanceolata** Wild. on October 23. A gall similar to that figured by Felt (11, fig. 165) was collected on **Schmaltzia lanceolata** Small. The adults reared November 1 may be **Asphondylia integrifoliae Felt.**

Biological Notes

1. **EUTRETA SPARSA** WIED. (11, p. 198, pl. 4, fig. 5)** **HOST:** Ratibida Columnaries D. Don, Cone flower, and Vernonia interior Small.*, Iron weed.

*The nomenclature of plants follows Small, J. K. 1913 Flora of the Southeastern United States, Ed. 2, New York.

**Numbers refer to literature cited at the end of the paper. References to figures are to those of the galls.

The gall (Pl. 1, fig. 12, 13) occurs on the stems of both hosts and in **Vernonia** is an oval swelling 6 x 10 mm. in size, often tinted with purple. On **Ratibida** the gall is an irregular oval swelling 10 x 17 mm. in size and usually occurs at the axis of a branch. The larva before pupation cuts a thin place in the wall. This is evident in one of the photographs. Galls are present from early April through May. Adults from both hosts emerged in cages, April 20 to May 30. Early in April empty galls and pupa cases were found in the crown of the perennial **Ratibida,** and a male was taken at flowers February 18. It appears probable that the insect overwinters in a gall in the crown of the plant. Galls were more abundant on **Ratibida** than on the other host.

2. **LASIOPTERA ALLIONIAE** FELT (13)

HOST: **Allionia** sp., Umbrella-wort.

The gall (Pl. 2, fig. 1) is a regular swelling of the stem 2.5 to 6 cm. long with a maximum of 1 cm. in width. Each gall is confined to a single node of the stem. The larvae burrow and feed in the pith, each gall containing many of them. The adults emerge by separate holes at any part of the gall. In all, five galls were collected near the small town of Dripping Springs, about 40 miles northwest of Austin.

On May 10, twenty females and six males emerged. On May 11, thirty-nine females and six males emerged. That day the five galls were placed in separate bottles to test the sex ratio from each. Three of the galls gave no more flies; from number 2 there emerged nine females and two males, from number 4, one female and one male.

On October 27, the following year, another gall that seemed to be the same species, was collected on **Allionia nyctaginae** Michx., on Barton Creek, near Austin and about eight miles above the springs.

The galls of this species yield insects of both sexes. Practically all the insects emerged; a total of sixty-nine females to fifteen males. There was no opportunity to determine the cause for this variation from the normal sex ratio.

3. **LASIOPTERA KALLSTROEMIA** FELT (13)

HOST: **Kallstroemia intermedia** Vail., Caltrop.

Two types of galls appear at about the same time. One (Pl. 1, fig. 1) consists of an irregular swelling of the stem about 1 cm. long by 5 to 9 mm. wide, of the same color as the stem, and occurring usually at the nodes. A single light orange colored larva feeds in the pith. The

other gall (Pl. 2, fig. 3) consists of an enlargement of the axis of the fruit. The single larva feeds on the tissue of the axis and often on the seeds. Aborting of the whole fruit sometimes results and the carpels do not separate. The beak, or exposed part of the axis becomes much broader at the base but no longer.

Galls are present on the stem from May until October; on the fruit during late fall. Adults were reared from the former in October and from the latter in November. There is no evidence concerning the stage in which the insect passes the winter. No parasites were reared.

4. **LASIOPTERA VERNONIAE** (Beutm) (**1**, p. 389, pl. 15, fig. 7; **4**; **10**; **11**.)

HOST: **Vernonia interior** Small and perhaps other species. Iron weed.

The galls (Pl. 1, fig. 14, 17) vary greatly in shape and occur on the stem, midrib, petiole and the receptacle of the flower. They are polythalmous, cylindrical, the larvae feeding in the pith. Stem galls are usually 30 x 10 mm.; the midrib swellings 25 x 5 mm. Adults of both sexes emerged May 11 to 16 from galls collected at Bastrop, Texas on an unidentified species of **Vernonia.** A female of the same species was reared from a midrib gall on **Vernonia interior** Small, collected at Austin. Similar galls occur on **Vernonia baldwinii** Torr. but adults were not reared. This species is heavily parasitized. The galls are present on the plants throughout the summer but all galls collected after August contained only larvae or pupae of parasites. According to Doctor Felt the specimens sent were a little different from type of this species.

5. **NEOLASIOPTERA ERIGERONTIS** FELT (**3**; **10**, fig. 37; **11**, fig. 231.)

HOST: **Leptilon canadense** Britt., Horse Weed

The gall (Pl. 1, fig. 11) is an irregular fusiform swelling 4 to 12 mm. long on the leaf petioles. They vary in size and shape and in June contain several tiny greenish larvae feeding in the pith. The leaves and galls remain on the stem throughout the winter. The adults emerge in March and the galls may be found in the field soon afterward. There appears to be only a single generation a year. This gall was collected both at Brownwood and Austin.

Galls on this plant, similar to those figured by Felt. (10; 11), were seen and collected in Texas but no adults were reared.

6. **NEOLASIOPTERA EUPATORII** FELT (**3**; **4**; **10**; **11**)

HOST: **Eupatorium serotinum** Michx. Late-flowering Thoroughwort.

The gall (pl. 1, fig. 7) is a cylindrical swelling varying in size with the part affected, and also varying from 1 to 4 cm. in length. The bright orange larvae feed in the pith of the gall.

The galls at all times are heavily parasitized rendering rearing difficult, but it seems that there are at least two broods as Itonidid pupae were seen in July. The insects reared emerged in August. Possibly the larvae spend the winter in the galls.

7. **DASYNEURA ULMAE** FELT (**4**; **7**; **11**, pl. 10 fig. 3.)

HOST: **Ulmus crassifolia** Nutt. and **U. americana** L. (?) Elm.

The gall is a single cell formed from an aborted bud, in general shape like a dog's tooth. The immature leaves are wrapped, overlapping, around the central cell and the galls are usually clustered at the tip of small twigs. The insects are heavily parasitized but one adult was reared about the middle of March. There appears to be only one generation a year. A very similar gall was found on **U. americana** L. but no gall makers were reared. This gall is exactly like that figured by Felt (11, pl. 10, fig. 3).

8. **PHYTOPHAGA ? CELTIPHYLLIA** FELT. (**4**; **8**; **11**, p. 122, 124, fig. 118)

HOST: **Celtis mississippiensis** Bosc., and **C. reticulata** Torr. Hackberry

The gall (Pl. 1, fig. 8) occurs singly or in groups of many galls; on the leaves, stem, and petioles. The gall is dark green, turning a rusty gray with age, subglobose to spherical, sometimes flattened on top, sometimes conical; with a small, distinct spike at the apex. It varies also in size; the average has a diameter and height of about 1 cm. and contains about six hardened cells with the larvae inside. The smooth outer wall is somewhat spongy on the outside, but hard next the larval chamber. The larval cells are arranged somewhat regularly around the center and vary from one (central) to twelve or fourteen.

There is a single generation a year. The adults emerge in March and the galls become evident in early April. The galls always appear on the current years growth, coming out as soon as the leaves open. This is

the most common hackberry gall about Austin and San Antonio.

In 1921 the galls were so common on some trees that a slight wind or rain would strew the ground with the gall-laden branches. This gall is much less common on **C. reticulata** where it appears hairy like the leaves of the host. A similar gall formed from the developing fruits, which was not reared may be the work of the same insect.

9. **PHYTOPHAGA PAINTERI** FELT. (14)

HOST: **Celtis reticulata** Torr. and **C. mississippiensis** Bocs. Hackberry.

The gall (Pl. 1, fig. 6) on the underside of the leaf is hemispherical, 3 by 2½ mm.; the wall folded into six to nine scallops, some of which are double. It is covered with long white hairs and tipped with a short, sharp, spike, lighter in color than the rest of the gall. The position of the gall is indicated on the upper side of the leaf by a brown spot, which is often surrounded by a lighter circle. The galls are green at first but turn tan, then dark brown early in the summer. They are thick walled, each containing a single larva.

The galls are more common on **reticulata** where they frequently occur in clusters on a single leaf. The adults emerge in March and the galls appear first in April. There is only one generation a year. No parasites were reared from this gall.

10. **PHYTOPHAGA SABINAE** FELT. (13)

HOST: **Sabina sabinoides** Small and **S. virginiana** Antione (?) Juniper.

The gall (Pl. 2, fig. 6) is short-conical in general shape; consisting of four modified scales, the outer two appressed but not completely covering the inner ones. These latter are darker in color and set at right angles to the others. Their edges join, forming a cell for the larva. The four top scales of the branch just below the gall are elongated by about one-half their usual length. The color is brown; the average length 1.5 mm.; width 1 mm.

This gall also appears on **S. virginiana.** No new galls were found in the summer. The new galls were first definitely identified in January. Two adults emerged March 31 and two April 3.

11. **PHYTOPHAGA TEXANA** FELT (14)

HOST: **Celtis reticulata** Torr. Hackberry.

The galls (Pl. 2, fig. 5) are found near the base of the leaf along the principal veins. They are hairy, cylindrical, truncate at apex and slightly at the base; peduncl-

ed and tipped by a short, brown, curved, tubercle. The galls are usually bent to one side and occur singly or in pairs, always on the under side of the leaf. In size they are about 4 mm. high by 2½ mm. wide. The cavity containing the whitish-orange larva is about the same shape as the gall and extends down into the peduncle. At first the galls are greenish, later they become tan colored. There is only one generation a year, the adults appearing in April.

12. **SACKENOMYIA PACKARDI** FELT (**5**; **8**, fig. 35; **11**. fig.)

HOST: **Salix nigra** Marsh. Willow.

The gall is an obling, cylindrical sweiling on the smaller stems of the willows, usually about 2 cm. long by 5 mm. wide. A few larvae feed in the pith of each gall. The color is brown like the surrounding bark.

A number of galls similar to those were collected December 22 at Lampassas, Texas. Four days later a small gray Itonidid emerged. No other insects were reared. It was probably an inquiline. All the other adults reared March 1 to April 17, were from galls collected at Austin and were quite different in appearance. A number of parasites also emerged. The galls may be present throughout the year but there are no records earlier than October. The gall is like that figured by Felt (8; 11).

13. **RHOPALOMYIA ANTHOPHILA** O. S. (**8**, pl. 1, fig. 3; **11**, fig. 213, pl. 12, fig. 5)

HOST: **Solidago canadensis** L., Golden rod.

This insect makes an aborted ovary gall; dark brown in color; cylindrical in shape; expanded near the base, thin walled and hollow. Each gall contains a single larva or pupa. A gall is formed from a single ovary, or sometimes two or three galls are solidified together, with the intervening wall left intact. Usually one, but sometimes three or four galls are found in each flower head. The gall is covered with short, stiff, hairs; and the shriveled flower-parts are occasionally present on the top.

The galls were collected only once, near Hamilton Pool, a locality 35 miles west of Austin. Twenty-two adults emerged on November 1; and twelve on the second. Both sexes were represented. Two of Felt's pictures (k, pl. 1, fig. 3, and 11, fig. 213) represent this gall very well.

14. **RHOPOLOMYIA SABINAE** FELT (**12**; **15**, fig. **7**)

HOST: **Sabina sabinoides** Small., Juniper.

This gall (Pl. 2, fig. 4) consists of a thick-walled, pink cell at the end of a branch; oval, sometimes obovoid in shape with a slight depression at the top. There are faint evidences of the separation into partitions as in the gall of **W. texana** especially at the top of the gall. A single larva is in the central cavity.

This gall, in common with most of the other cedar bud galls, appears in the late fall, their period of maturing is somewhat coincident with the flowering of the cedars. What becomes of these insects during the rest of the year is not known. This gall is found also on **Sabina virginiana** Antoine. It is similar in color to that of **Walshomyia texana** Felt but quite different in structure. An adult was reared April 3.

15. **WALSHOMYIA TEXANA** FELT (11, 15, fig. 9)
HOST: **Sabina sabinoides** Small; and **S. virginiana** Antoine. Juniper.

The gall (Pl. 1, fig. 3) consists of the enlarged tip of a branch which has turned pink. The gall is divided into ten equal sections, has thin walls and contains a single cavity. It is 6 to 7 mm. long by 4 to 5 mm. wide.

There is probably only one generation a year, the insect passing the winter in the gall. The adult midges emerge through the extreme tip of the gall, where the sectors meet; parasites, however, gnaw through at any point.

The adults emerge in late March and early April. A photograph of the gall is included in Patterson's paper (14, fig. 9).

16. **ASPHONDYLIA ABUTILON** FELT. (14)
HOST: **Abutilon incanum** Sweet. Indian Mallow.

The gall (Pl. 2, fig. 2) consists of the elongated and closed sepals of the flower; the orange-colored Itonidid larva apparently eats the stamens and other flower parts. The gall varies in length and size according to the time at which it is infested. Usually it is about 7 mm. long. Galls are present from July until November.

They are very numerous on some plants, sometimes preventing the formation of seeds. There were few parasites reared.

One male emerged on August 8 and another on the 9th. Two females emerged on October 25 and eight females and five males on the 29th.

17. **ASPHONDYLIA AMARANTHI** FELT (14)
HOST: **Amaranthus blitoides reverchonii** Uline and Bray.

The gall (Pl. 2, fig. 8) is formed from the aborted and elongated ovary or seed and is over twice the ordinary seed length, but scarcely as wide. The galls are 4.5 mm. long and 1.8 mm. wide.

This gall was collected only once, December 8 but its inconspicuousness renders it probable that it has often been overlooked. Six adults emerged December 19.

18. **ASPHONDYLIA AUTUMNALIS** BEUTM. (1, pl. 13, fig. 1, 2, 9, 11)

HOST: **Helianthus annuus** L., Sunflower and **Helenium microcephalum** D. C., Sneezweed.

The gall on **H. annuus** consists of an enlargement of the ovary of the flower, at the time when it is in the bud. The other flower parts generally remain attached to the top of the gall which is generally yellowish in color. The size and shape varies much with the part of the disk on which the gall grows. Both ray and disk flowers are infested; a single larva is in each. The galls occur quite commonly in the valley of Shoal Creek near Austin, during the month of October. They have not been collected elsewhere, nor is the rest of the life history known.

On **H. microcephalum** the gall is formed of the enlarged, but scarcely thickened corolla of the disk flower. The top of the flower is united as in the bud. No injured ray flowers were observed. The color is yellow, darker at the top; only slightly protruding from the surface of the tops of the other disk flowers. The galls are three or four times the width of normal flowers. Only a single flower is changed in each gall and one larva is in each. Adults emerged December 10 to 19; seven of undetermined sex and twenty-five males and seven females. Although this weed is common, the gall is very local in distribution, and not at all common. The gall figured by Beutenmuller is not like the ones collected in Texas.

19. **ASPHONDYLIA BUDDLEIA** FELT. (14)

HOST: **Buddleia ramosa** Torr.

The gall (Pl. 2, fig. 10) is formed of the enlarged and slightly thickened corolla, the top united as in the bud; about twice the length of an ordinary flower, but very little enlarged in width. The gall is slightly less pilose than is usual among these flowers, and is yellowish white in color; about 4.5 mm. long by 2 in width. A single larva is found in each.

A few of these galls were found on upper Barton Creek, Austin. The plant is abundant among the limestone bluffs but the galls are scarce. On November 13

two females and one male emerged. The galls were collected only once.

20. **ASPHONDYLIA BUMELIAE** FELT. **(4; 9; 11)**

HOST: **Bumelia lanuginosa** Pers., Gum Elastic.

The gall (Pl. 1, fig. 16) is an irregular swelling on small branches and varies in size from 1 to 10 cm. in width. The larvae lie in small round cells scattered through the cambian layer of the gall. Those first appear as small transparent spots, even before the larvae are visable. The swelling retains the rough bark. Galls are present throughout the year and were collected also at Brownwood, Texas. Parasites which are abundant; appear with the adult midges in May.

21. **ASPHONDYLIA CLEMATIDIS** FELT. **(14)**

HOST: **Clematis drumondii** T. and G., Grandaddy Gray beard.

The galls (Pl. 1, fig. 5) are polythalmous or single; each gall consisting of a roughly spindle-shaped cell with walls 1 mm. thick. The outer surface is wooly with long hairs. The gall generally appears on the buds at the axils of the leaves and branches; it also is found on the flower-parts at the base of the stamens and pistil and is sometimes capped by the persistent, plumose, style. The adults were reared in August and the galls are heavily parasitized. New galls appear in July but there was no evidence as to how the insect over-winters.

22. **ASPHONDYLIA LACINARIAE** FELT. **(14)**

HOST: **Lacinaria punctata** kuntze. Blazing Star.

The gall which this species forms is an irregular, subpherical, polythalmous stem gall about 2cm. long by 1½ cm. wide. Galls were collected April 12 and several adults emerged April 15.

23. **ASPHONDYLIA MIMOSAE** FELT. **(13)**

HOST: **Mimosa fragrans.** A. Gray., Cat Claw.

This insect has been reared from two very different types of galls, whose relationship to each other is not entirely clear. The first (Pl. 1, fig. 2) is a thin walled oval gall formed from the enlarged and aborted ovary of the flower and resembles the summer gall of **Asphondylia prosopidis** Ckll. The galls are found in clusters on the ends of the flower peduncles, and are often tipped by parts of a mature seed pod. There are sometimes ripe pods on the same peduncle. The color is greenish pink; the average size 7 by 2½ mm. The two adult males emerged February 19 and 21. This is just before the

spring appearance of the leaf buds and flowers. The new galls which come on, appear to persist until the following spring, but the galls were found on only one or two occasions and the life history was not followed completely.

The second type of gall (Pl. 1, fig. 4) is a variable bud, thorn and petiole gall which is roughly cone shaped, about 9 mm. high, of varying width, but narrower at the top. Each gall contains one to several fusiform larval cells, open at the top and each containing an orange larva. At first the color of the gall is reddish green but later turns brown. A male and a female were reared November 16 from galls collected November 12. When these were collected they were greenish red, while most of the other galls were brown and empty. The gall is common at Austin and at Brownwood but is heavily parasitized; the galls evidently persist on the bushes for several months after the adults emerge. It is possible that the insect has a regular alternation of these two types of galls as does **Asphondylia prosopidis** Ckll. or the two may develop side by side as in other species of this genus.

24. **ASPHONDYLIA PROSOPIDIS** CKLL. **(2; 9; 11; 14)**

HOST: **Prosopis glandulosa** Torr., Mesquite.

The summer form of the gall (Pl. 1. fig. 9) is present from May until August and consists of the aborted and enlarged ovary of the mesquite flower. It is green or pinkish ovoid, 2½ by 10 mm. tipped by the curved stigma and style of the flower and still surrounded by other withered flower-parts. A central cavity with thin walls contains a single yellowish larva. The gall is common at Austin and Brownwood and in both cases the insects appear to prefer smaller trees or bushes. The galls appear, mature quickly, and drop from the flower stem. There are probably several generations which are all heavily parasitized. The adults of both sexes, reared, emerged in June and July but new galls appear with the flowers at various times through the summer.

The winter form of this gall (Pl. 1. fig. 10) is present from August until the following April. It consists of a curved spindle-shaped gall formed from the enlarged ovary and style of the flower, 6 by 2 mm., situated on the thickened flower peduncle. The gall proper and the peduncle are brown, scaly and like the bark of the tree, thus quite different from the spring form. A single cavity in the center of each aborted ovary contains the larva which remains very minute until February. During

March the larva grows quickly and the gall expands to two or three times its previous size, cracking its bark-like covering and exposing the green tissue beneath. Many parasites were reared. When these are present they usually prevent this spring expansion of the gall. Adults of both sexes of the gall maker emerged in mid April.

No experiments were conducted in which adults from one type of gall produced galls of the other type. However the mutually exclusive dates of the two types of galls and the fact that the adults were identical constitute very good evidence that such is the case. If so this is perhaps the first step toward a complex life history such as has been developed among the Cynipidae.

25. **ASPHONDYLIA RATIBIDAE** FELT. (14)

HOST: **Ratibida columnaries** D. Don., Cone flower.

The spring and summer galls occur on the flowers (Pl. 1, fig. 15), the autumn galls on the leaf buds (Pl. 2, fig. 7). In the former case they are formed from the ovary and flower parts of both ray and disk flowers. The tops of the young flowers are sealed up and the walls beneath thicken greatly. Each deformed floret contains a single larva. The autumn gall is formed in the enlarged end of a stem or leaf bud. They are usually found in the axils of the leaf at the base of the plant and prevent further growth of the bud. The gall is thin walled 5.5 mm. in diameter and contains a single larva.

The flower galls are present from early April through the summer, the adults emerging in May and June. In the latter part of the summer, galls are a little different in appearance and contained only parasites and inquilines. After the flowers have disappeared the bud galls are formed and are present from August to October. Adults emerge in October but there is little evidence that the species overwinters in this particular gall. Hymenopterous parasites were very common on this species.

26. **ASPHONDYLIA VERBENAE** FELT. (14)

HOST: **Verbena halei** Small.

The gall (Pl. 2, fig. 9) consists of parts of the aborted ovary and lower corolla-tube. In the case of those containing larvae the inside of the tube becomes quite pubescent; but this disappears with the formation of the pupa. The length is 5 mm., the width 2 mm. The upper part of the corolla retains the bud-like structure until the adult pushes through it.

The galls appear as buds until the fruits mature.

Galls were collected at Oak Hill and on Upper Barton Creek, near Austin during the early fall. One male emerged October 15, and one October 23.

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Plate I

Fig. 1. Gall of **Lasioptera kallstroemia** Felt on stem of **Kallstromia intermedia** Vail.

Fig. 2. Gall of **Asphondylia mimosae** Felt. on ovary of **Mimosa fragrans** A. Gray.

Fig. 3. Gall of **Walshomyia texana** Felt. on bud of **Sabina sabinoides** Small.

Fig. 4. Galls of **Asphondylia mimosae** Felt. on buds of **Mimosa frangrans** A. Gray.

Fig. 5. Galls of **Asphondylia clematidis** Felt on buds of **Clematis drummondii** T. and G.

Fig. 6. Gall of **Phytophaga painteri** Felt on leaf of **Celtis reticulata** Torr.
Fig. 7. Gall of **Neolasioptera eupatorii** Felt on stem of **Eupatorium serotinum** Michx.
Fig. 8. Gall of **Phytophaga celtiphyllia** Felt on branch of **Celtis mississippiensis** Bosc.
Fig. 9. Summer galls of **Asphondylia prosopidis** Ckll. on ovaries of **Prosopis glandulosa** Torr.
Fig. 10. Winter galls of **Asphondylia prosopidis** Ckll on ovaries of **Prosopis glandulosa** Torr.
Fig. 11. Galls of **Neolasioptera erigerontis** Felt on leaf petioles of **Leptilon canadense** Britt.
Fig. 12. Gall of **Eutreta sparsa** Wied. on stem of **Vernonica baldwinii** Torr.
Fig. 13. Gall of **Eutreta sparsa** Wied. on stem of **Ratibida columnares** D. Don.
Fig. 14. Gall of **Lasioptera vernonae** on stem of **Vernonia** sp.
Fig. 15. Galls of **Asphondylia ratibidae** on flowers of **Ratibida columnares** D. Don.
Fig. 16. Galls of **Asphondylia bumeliae** on branches of **Bumelia lanuginosa** Pers.
Fig. 17. Galls of **Lasioptera vernonae** on leaf mid rib of **Vernonia interior** Small.

Plate II

Fig. 1. Stem gall of **Lasioptera allioniae** Felt on **Allionia** sp.
Fig. 2. Gall of **Asphondylia abutilon** Felt on flower bud of **Abutilon incanum** Sweet.
Fig. 3. Gall of **Lasioptera kallstroemia** Felt on fruit of **Kallstroemia intermedia** Vail.
Fig. 4. Gall of **Rhapalomyia sabinae** Felt on **Sabina sabinoides** Small.
Fig. 5. Gall of **Phytophaga texana** Felt on leaf of **Celtis reticulata** Torrey.
Fig. 6. Gall of **Phytophaga sabinae** Felt on **Sabina sabinoides** Small.
Fig. 7. Gall of **Asphondylia ratibidae** Felt on buds of **Ratibida columnares** D. Don.
Fig. 8. Gall of **Asphondylia amaranthi** Felt on fruit (lower) of **Amaranthus blitoides reverchonii** and normal fruit (upper).
Fig. 9. Gall of **Asphondylia verbenae** Felt on flower (lower) of **Verbena halei** Small, and normal fruit (upper).
Fig. 10. Gall of **Asphondylia buddleia** Felt (left) on flower cluster of **Buddleia ramosa** Torr.

Plate I

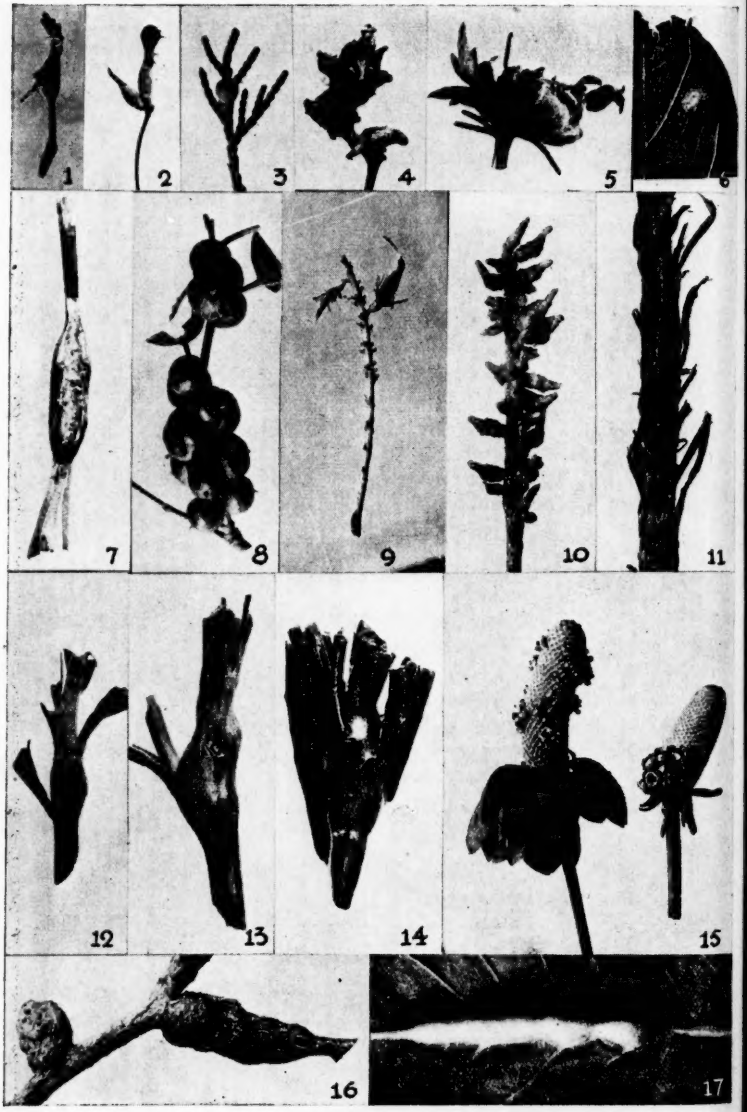
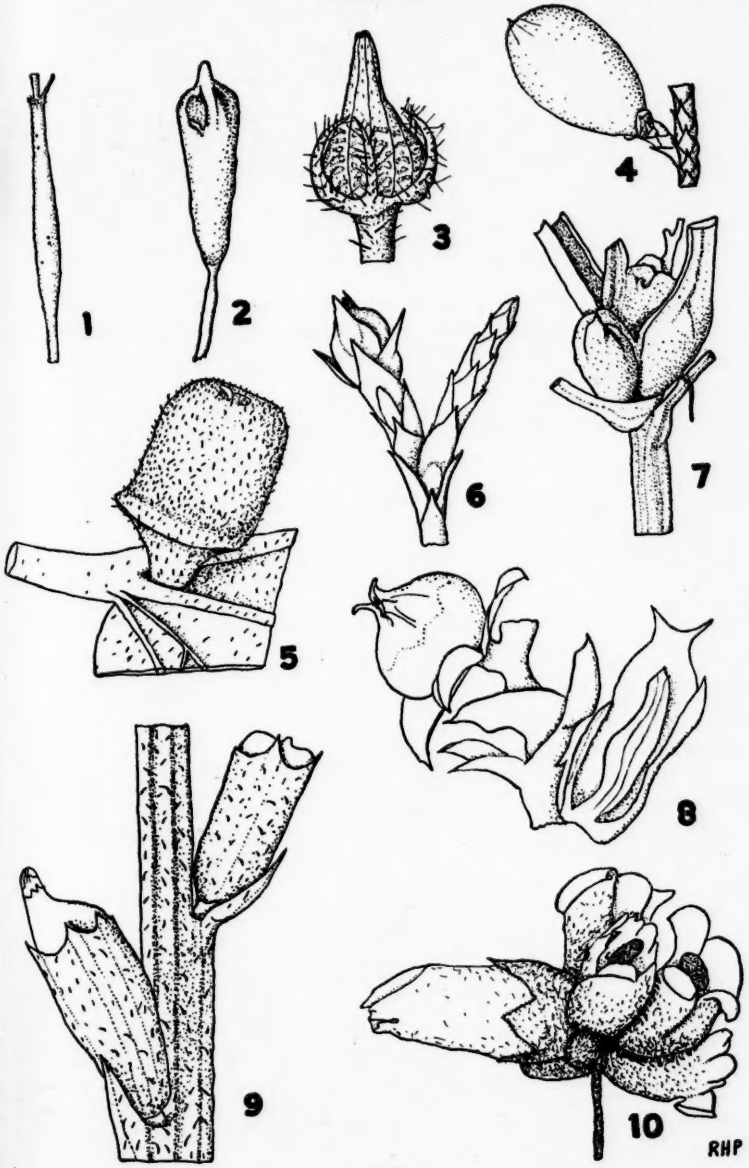


Plate II



TEN NEW SPECIES OF ERYTHRONEURA (HOMOPTERA, CICADELLIDAE)

R. H. BEAMER, Lawrence, Kans.*

The following ten new species of **Erythroneura** belong to the Obliqua group as divided by McAtee. The types are in the Snow Entomological Collection unless otherwise stated. These are but a part of a very considerable number of forms which I have as yet been unable to place satisfactorily. The oedagus and style of each species are shown in the plate.

Erythroneura torva n. sp.

Resembling **Erythroneura coarctata** Beamer but with light venter and oedagus with long processes instead of very short ones. Vertex quite acute.

General ground color semihyaline to yellowish white. Vertex with inverted orange V usually touching eyes, continued across pronotum as two slightly diverging vittae. Scutellum with tip orange, basal angles yellow. Elytra with usual three pairs of orange stripes. Venter stramineous.

Genitalia: Style with medium foot, base straight; anterior point narrow, sharp, continuing out from tip of foot; posterior point at least twice as broad and about as long. Oedagus of medium length, evenly curved dorsally in lateral view, tip flattened, shaft with ventral pair of processes arising near base, lying along shaft, ending near tip.

Holotype male, allotype female, 8 female and 4 male paratypes, New Haven, Conn., Aug. 20, 1934, R. H. Beamer; 1 male Glen Echo, Md., Mar. 21, 1931, P. W. Oman; 1 male Glen Echo, Md., Feb. 22, 1931, P. W. Oman; and 1 male Wash. D. C., Oct. 11, 1932, P. W. Oman, also paratypes. Paratypes in U. S. Nat. Museum.

Erythroneura mansueta n. sp.

Near **Erythroneura cruciformis** Beamer but lateral processes on shaft of oedagus longer, more slender, and nearer the base; foot of style practically without anterior and posterior points.

General ground color semihyaline to pinkish white. Vertex with inverted orange V, usually not touching eyes, continued across pronotum as two diverging narrow vit-

*Contribution from Department of Entomology, University of Kansas.

tae, scutellum with basal angles yellow, tip orange, Elytra with usual three pairs of oblique vittae. Cross veins and veins often pink with slight infuscation near former. Venter stramineous tinged with pink.

Genitalia: Style with short stout foot; heel small but pronounced; base straight; anterior point about a right angle; posterior point about the same with sometimes a slight indication of a sharper projection. A definite ridge connects heel with anterior point giving the appearance of a very broad short posterior point. Oedagus long, slightly curved dorsally, with very long slender lateral processes at right angles to shaft about one fourth distance from base, often knobbed at tip; shaft ends in a dorsoventrally flattened tip.

Holotype male, Johnson County, Ill., March 30, 1929, R. H. Beamer; allotype female and 1 male paratype Shuqualak, Mississippi, July 16, 1930, R. H. Beamer; 2 male paratypes one from Clearwater, La., Dec. 24, 1931 and the other from Caddo Parish, La., Dec. 12, 1931, R. H. Beamer.

Erythroneura perita n. sp.

Resembling **E. magnacalx** Beamer but with unusually small heel on style of male and processes at base of oedagus larger and projecting away from shaft at about a 45 degree angle.

General ground color semihyaline to white. Markings orange. Vertex with inverted orange V barely touching eyes; continued across pronotum as two diverging vittae. Scutellum with basal angles yellow bordered on inner margin with orange; tip orange. Elytra with usual three pairs of oblique stripes. Venter stramineous tinged with pink on certain portions of face and thorax.

Genitalia: Style with long foot, almost no heel; base straight; anterior point slightly more than right angle; posterior point about as long as toe is wide with converging sides. Oedagus with long shaft, almost straight, narrowed just before tip to end in a Y-shaped lip; pair of sharply diverging processes ventrad to base of shaft, scarcely half as long as shaft.

Holotype male, Cherokee Co., Kansas, 1928, R. H. Beamer; paratypes as follows: 1 male Anderson Co., Kansas, Nov. 26, 1927, R. H. Beamer; 1 male, Douglas Co., Kansas, 1927, R. H. Beamer; 1 male, Plummers Id., Md., Jan. 13, 1929, W. L. McAtee; 1 male, Washington,

D. C., Oct. 1, 1932, M. J. Oman; 1 male, Washington, D. C., Feb. 22, 1932, P. W. Oman. Types in Snow Collection, paratypes in Collection of W. L. McAtee and Collection of U. S. N. M.

Erythroneura cauta n. sp.

Resembling **E. parvaspicata** Beamer but usually with orange and dark markings heavier; posterior point of style much longer and tip of oedagus scarcely narrowed dorsoventrally.

General ground color semihyaline to whitish marked with orange. Vertex with heavy inverted V, much enlarged next eyes. Pronotum with two diverging vittae not reaching either margin but run together to form an orange disc. Scutellum with basal angles yellow outlined with red; tip red. Elytra with usual three pairs of oblique vittae, one on clavus, one on costal margin and one near middle of coria. Cross veins more or less spotted with fuscous. Dorsum of abdomen quite dark, showing distinctly through elytra. Venter: face usually pink, mesosternum and abdomen usually quite dark.

Genitalia. Style with heavy foot; heel marked; base slightly curved; outer point short, about a right angle; posterior point a little more than half as long as base, slender, sharp. Oedagus slender, without processes, curved some distance dorsally, beyond opening of duct laterally flattened, scarcely narrowed dorso-ventrally toward tip.

Holotype male, 1 male paratype, Colfax, La., Dec. 23, 1931, R. H. Beamer; paratypes, 3 males, Clearwater, La., Dec. 24, 1931, R. H. Beamer; 1 male, Washington, D. C., Oct. 14, 1932, P. W. Oman.

Erythroneura idonea n. sp.

Resembling **E. scissa** Beamer but much larger; foot of style with anterior point much longer and posterior point much shorter, much more like foot of style of **E. rubroscuta** (Gill.); oedagus with lateral teeth sharp and at tip.

General ground color semihyaline to yellowish white with orange marks. Vertex with broad inverted orange V often touching eyes; continued almost across pronotum as diverging vittae. Scutellum with basal angles yellow, tip orange. Elytra with usual three pairs of oblique stripes. Apex delicately fumose. Venter stramineous more or less tinged with pink.

Genitalia: Style with very slender foot, ending in a prolonged anterior point; heel small; posterior point short, about one third as long as anterior, located about midway between heel and tip of anterior point. Oedagus with long shaft, more or less tapering from base to tip where it abruptly widens laterally into quite sharp processes as long or longer than shaft is wide.

Holotype male, allotype, female and numerous male and female paratypes, Marshall, Ark., March 22, 1931, R. H. Beamer and L. D. Anderson.

Erythroneura afflicta n. sp.

Resembling **E. unicuspidis** Beamer but oedagus with long retrorse spine ventrally near tip.

General ground color semihyaline to yellowish white marked with orange. Vertex with orange inverted V enlarged near eyes; continued across pronotum as two almost parallel vittae. Scutellum with basal angles yellow, bordered with orange on inner margins, tip orange. Elytra with usual oblique stripes, very delicate infuscations near cross veins. Venter stramineous.

Genitalia: Style with medium foot; heel prominent; base almost straight; anterior point almost as wide as long, about half as long as base. Oedagus of medium length, enlarged at tip in lateral view to a lobe dorsally and with a long retrorse spine ventrally; pair of processes arise ventrally at base and project out surrounding spine.

Holotype male, and three male paratypes, Glen Echo, Md., Feb. 22, 1931; 4 male paratypes, Glen Echo, Md., March 21, 1931; 1 male, Plummers Id., Md., Jan. 13, 1929, W. L. McAtee. Holotype and paratypes in Snow Collection. Paratypes in U. S. National Museum and Collection of W. L. McAtee.

Erythroneura jocosa n. sp.

Resembling **E. obliqua** (Say) but oedagus without basal processes and with lateral processes near tip of shaft.

General ground color semihyaline to yellowish white. Vertex with inverted orange V widened to just touch eyes; continued across pronotum as two narrow, slightly diverging vittae. Scutellum with basal angles yellow, tip orange. Elytra with usual three pairs of orange vittae; one on clavus, one on Cu, and other on costal margin to cross veins exclusive of costal plaque. Fuscous

spots opposite bases of cells R4, M2, and M4. Body stramineous tinged with pink on face and sides of thorax.

Genitalia: Style with medium foot; heel sharp; base straight; anterior point about a right angle; posterior point sharp, about as long as toe is wide. Oedagus with shaft of medium length, sides parallel in ventral view, widened one fourth distance from tip by two processes parallel to shaft, extending to tip where they are bent out at right angles.

Holotype male, Anderson Co., Kansas, Sept. 9, 1927, R. H. Beamer; paratypes as follows: 4 males, Eunice, La., Dec. 24, 1931; 1 male Douglas Co., Kansas, 1927, R. H. Beamer; 1 male, Rankin, Mo., Feb. 23, 1930, R. Swain.

Erythroneura nava n. sp.

Resembling **E. idonea** Beamer but much smaller and with posterior point of style about same length as anterior instead of much longer, with oedagus shorter, more curved in lateral view, and with a different tip.

General ground color semihyaline to whitish marked with orange. Vertex with inverted V usually touching eyes; continued across pronotum as two slightly diverging vittae. Scutellum with basal angles yellow bordered with orange on inner margin; tip orange. Elytra with usual three pairs of oblique vittae. Venter stramineous, tinged with pink on face.

Genitalia: Style with medium sized foot; heel distinct; base slightly swollen; anterior point long and sharp, slightly narrower than posterior but about same length, their outer faces forming almost a straight line. Oedagus curved dorsally in lateral view, heavy; almost parallel sided most of length converging on outer fourth to flat bi-lobed tip.

Holotype male, Johnson Co., Ill., March 30, 1929, P. W. Oman. Paratypes as follows: 2 males, Clearwater, La., Dec. 24, 1931; 1 male, Eunice, La., Dec. 24, 1931; R. H. Beamer; 1 male, Washington, D. C., May 6, 1934, P. W. Oman. Types in Snow Collection. Paratypes in U. S. N. M.

Erythroneura apta n. sp.

Resembling **E. nava** n. sp. but with anterior point of style much longer than posterior and tip of oedagus laterally flattened instead of dorso-ventrally.

General ground color semihyaline to yellowish white.

Vertex with inverted orange V usually touching eyes, continued across pronotum as two almost parallel vittae. Scutellum with tip orange, basal angles yellow. Elytra with usual three pairs of orange vittae. Venter straminęous, face tinged with pink.

Genitalia: Style with small foot, base straight, anterior point very long, longer than foot is wide at apex, posterior point not half as long as anterior, outer margins of points forming almost a straight line. Oedagus rather short, heavy at base in lateral view, narrowed to dorsally bent tip.

Holotype male, and two paratypes males, Colfax, La., Dec. 23, 1931, R. H. Beamer; one paratype male, Polk Co., Ark., December 19, 1931, R. H. Beamer.

Erythroneura nitida n. sp.

Resembling **apta** n. sp. but summer specimens with much brighter red stripes, and oedagus of male with pair of processes.

Ground color white tinged with yellow. Vertex with orange inverted V usually touching eyes, continued across pronotum as two diverging vittae, in summer specimens these vittae becoming red posteriorly. Scutellum with basal angles yellow. Elytra with mesal two pair, of oblique vittae bright red; costal pair yellow.

Genitalia: Style with medium foot, base straight; anterior point long as width of foot, narrow; posterior point twice as wide as anterior, about as long. Oedagus in lateral view broad at base, slightly curved dorsally gently narrowed to round tip with pair of ventral processes arising at base and extending slightly more than half its length.

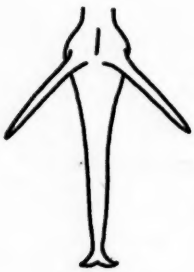
Holotype male, allotype female, 8 male and 10 female paratypes, Bretton Woods, N. H., Aug. 31, 1934, R. H. Beamer. This species was swept from **Spirea** sp. on swampy ground.

1 E. torva

1a

2 E. mansueta

2a



3 E. perita

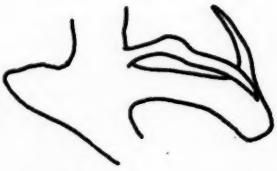
3a

5a

4 E. cauta

4a

5 E. idonea



6 E. afflicta

6a

7 E. jocosa

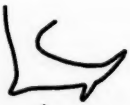
7a

8a

9 E. apta

10 E. nitida

8 E. nava



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10a

THE VITTATE SPECIES OF THE GENUS MADIZA
(Diptera, Chloropidae)

CURTIS W. SABROSKY, Kansas State College.

During the preparation of a paper* on the Chloropidae of Kansas, in which 75 species and three named varieties are recorded from the state, several undescribed species of the genus **Madiza** were discovered. The descriptions of these species are presented here, preliminary to the appearance of the faunal survey. Since the species of the genus are often very similar and difficult to distinguish, the descriptions purposely have been made rather detailed.

The vittate species of the genus **Madiza** do not constitute a natural grouping, as might be implied by the title. In reality, two groups are represented. In one group, the mesonotum has a black ground color, more or less gray pollinose; in the other group, the mesonotum is yellow. For convenience, however, they are considered together in this paper. **Madiza pumilionis** (Bjerk.), which was recorded from New Jersey in Smith's List (1910) also belongs in this group, but specimens have not been seen by the author and it is not included in the key. It would run to **projecta** Mall., from which it differs in having three spots on the pleura, and black pilosity, on the basis of the descriptions.

KEY TO THE VITTATE SPECIES OF THE GENUS MADIZA IN NORTH AMERICA

1. Thorax black, gray to brownish-gray pollinose .....2.
   Thorax with yellow ground color .....3.

2. Mesonotum with five narrow, brown vittae, including a median and two dorsocentral stripes, and a short vittula above the base of each wing; postvertical bristles present, but very short and not evident; proboscis short, the distal portion yellowish .....quinquelineata (Ad.)

   Mesonotum with four pale brown vittae, situated on either side of, but not including, the dorsocentral and median lines: postvertical bristles long, cruciate; proboscis long, shining black .....
   ..... quadrivittata, new species.

   Mesonotum pale gray, with three broad, brown vittae on the median and dorsocentral lines; prob-

*In press, Transactions of the American Entomological Society.

oscis very long, shining black, each portion longer than the head; postverticals long, convergent ....trivittata, new species

3. Mesonotum yellow, with reddish-gray to dull black vittae; hairs pale yellow; second costal sector distinctly longer than the third sector (1½-2 times) ....4.

Mesonotum with four short yellow vittae on a reddish-gray disk; hairs black; third costal sector longer than the second, or at most the sectors subequal ..... submarginalis, new species.

4. Mesonotum with three dark gray longitudinal stripes; antennae yellow, the third segment light brown on the upper margin; vertical triangle yellow, with a large, circular, shining black spot just below the ocelli, in addition to the dull black ocellar spot .....punctifrons (Beck.)

Very similar to **punctifrons**; triangle without the shining black spot below the ocelli ....projecta Mall.

Madiza quinquelineata (Adams)

1904. Siphonella quinquelineata Adams, Psyche, 11, p. 104. [La., Ga.].

Adams' original description is as follows:

"Black, gray pollinose, mesonotum marked with five brown lines. Occiput, frontal triangle, and frontal orbits grayish pollinose; front brownish black, anterior margin and a median line fulvous; antennae brownish black, inner side of joints yellowish, face, cheeks, and palpi yellow, proboscis with basal half black, apical half yellow. The two lateral vittae of the mesonotum short and very indistinct, the short pile yellowish white; halteres yellow. Abdomen brownish black; posterior margins of segments yellowish. Legs with coxae, femora, and middle and hind tibiae largely black, remaining parts yellow. Wings hyaline. Length 1.7 mm.

"Four specimens, Opelousas, La., and Tifton, Ga. April, June and October."

The characteristic appearance of the mesonotum and the front makes this species rather easy to recognize. The type has not been studied, but a series of specimens from various localities has made it possible to add the following notes to the diagnosis of the species:

Head: occiput entirely gray pollinose, with a gray stripe extending forward mesally to the apex of the triangle; orbits narrowly gray, somewhat whitish anteriorly; the intervening areas form dark brown stripes which

extend from the vertex across the posterior angles of the triangle almost to the anterior margin of the front, and separated on the anterior half of the front by a narrow yellowish stripe which is a continuation from the apex of the triangle (fig. 1). Third antennal segment orbicular; arista black, microscopically pubescent, the basal segment enlarged and quite elongate. The face is rather short and the median carina very prominent and sharp, the antennal grooves deep. Eyes with short, pale pubescence. Oral opening considerably longer than broad; clypeus shining black; distal portion of the proboscis slightly shorter than the proximal. Under low power the head, as well as the remainder of the insect, appears to be bare, but under high power (60x) a few short bristles can be seen. These include a row along each side of the triangle, a few fronto-orbitals, and slightly longer and stouter ocellars and inner and outer verticals.

Thorax as in Fig. 1. The dorsocentral stripes pass to the apex of the scutellum, leaving a median stripe and the sides of the scutellum gray pollinose. There is usually only a single row of punctures, each bearing a short black hair, between the median and the dorsocentral vittae, although some specimens have 2-3 irregular rows. The usual pairs of bristles—1 anterior and 2 posterior notopleural, 1 postalar, 1 posterior dorsocentral. 1 apical and 2 subapical marginal scutellars—are short and not very prominent. The gray areas of the scutellum are smooth, but the brown stripes have several rows of punctures. Halteres with yellowish-white knob and pale brown pedicel.

Legs: knees, apical halves of mid and hind tibiae, and tarsi except for the distal segment or two, yellow. Fore tibiae usually yellow, often darkened on the outer surface near the base. "Sensory area" long and narrow.

Wings as in Fig. 2. There is some variation in the relative lengths of the costal sectors, but the second is always distinctly longer than the third, usually about 1½ times.

Distribution*: **Arkansas:** 3 ♀, Polk County, Aug. 21, 1928, (L. D. Beamer); 1 ♀, same data, (J. G. Shaw) [Snow Colln.]; 1, No. 161 (probably Fayetteville) [Ar-

*All specimens recorded in this paper have been seen by the author. Special thanks are due to Professor D. A. Wilbur for many fine specimens from his studies of the insect fauna of grasslands.

kansas Univ. Colln.]. **Georgia:** 1 ♀, Wrens, Aug. 22, 1930, (R. H. Beamer) [Snow Colln.]. **Iowa:** 1, Mt. Pleasant, May 23, 1928, (Hookom); 1 ♀, Mt. Pleasant, May 20, 1930, (O. Smith) [Iowa Wesleyan College Colln.]. **Kansas:** 1 , Ottawa County, June 24, 1934, (C. W. Sabrosky); 1, Riley County, May 8, (C. W. Sabrosky); 12 (4 ♂, 4 ♀, 4?), Riley County, June 6, 18, and 30, 1930, (D. A. Wilbur), sweeping pasture grasses [Kansas State College, and Author's Colln.]. **Missouri:** 1, Atherton, May 21, 1901 [Arkansas Univ. Colln.]. **South Carolina:** 1 ♀, Tigerville, Aug. 20, 1930, (R. H. Beamer) [Snow Colln.]. **South Dakota:** 1 ♀, Elk Point, June 19, 1924, (F. M. Hull); 1 ♀, Winner, July 2, 1924, (F. M. Hull) [S. Dak. State College Colln.]. **Texas:** 1 ♂, 1 ♀, six miles N. of Brownsville, July 20, 1933, (R. K. Nabours and C. W. Sabrosky) [Author's Colln.]; 1 ♂, 6 ♀, College Station, Mar. 16 and 20, 1934, (H. J. Reinhard); 1 ♂, 1 ♀, College Station, April 1, 1934, (H. J. Reinhard) [Texas A & M College Colln.].

Madiza quadrivittata, new species.

A dark gray pollinose species; mesonotum with four brown vittae, the median pair slightly shorter than the outer pair, and both failing to reach the scutellum. Back part of the head, the thorax, dorsum of abdomen, and legs, predominantly black. 1½—1¾ mm.

♂, ♀.—Head black, the orbits whitish, the anterior third of the front, lower portions of the antennal segments, the short pubescent arista, face, cheeks, and palpi, yellowish to orange. Posterior two-thirds of the front brown. Clypeus and proboscis shining black, each section of the latter as long as the head. Triangle gray pollinose, subshining, touching the eyes at the vertex and tapering sharply to a point about midway on the front, whence it is continued as a narrow, acuminate orange stripe to the anterior margin of the front. Cheeks narrow, slightly less than the diameter of the third antennal segment, or 1/5 the height of the eyes. Eyes with short, pale pubescence. Hairs on the front pale. Bristles black: 6 or 7 pairs of short fronto-orbitals, 1 ocellar, 1 long, cruciate postvertical, 1 inner and 1 outer vertical. Vibrissal hair weak but distinct.

Thorax black, entirely dark gray pollinose except for the polished propleura, posterior half of the sternopleura, and the metanotum. Disk of the mesonotum and scutellum covered with short, pale hairs; the punctures

which bear the hairs are arranged in rather definite rows, and among these, the median and dorsocentral rows are distinct. Four vittae of brown pollen lie on the intervening areas (Fig. 3), leaving equally broad, gray pollinose areas in the median and dorsocentral positions. Bristles as in **quinquelineata,** but longer and more prominent, the pair of cruciate apical scutellars almost twice the length of the others. Halteres with white knob and yellow pedicel.

Dorsum of abdomen dark brown, the hind margins of the segments narrowly yellow, and the apex of the abdomen broadly yellow. Male hypopygium shining black.

Legs predominantly black; the fore coxae obscurely, and the knees, bases and apices of tibiae narrowly, and the tarsi except for the distal segment, yellow.

Wings clear, veins brown; venation as in Fig. 4.

Type: ♂, Manhattan, Kansas, Sept. 27, 1934, (C. W. Sabrosky), swept from a species of aster [Author's Colln.].

Allotype: ♀, Warren Grove, N. J., July 24, 1923, (J. C. Bradley) [Cornell Univ. Colln.].

Paratypes: 2 ♂, same data as the allotype.

Madiza trivittata, new species.

Small, gray pollinose species, with three brown vittae on the mesonotum, and very elongate, geniculate, shining black proboscis. ♂, 1½mm.; ♀, 2 mm.

♂, ♀. Head large, slightly higher than long; front similar to **quinquelineata,** orange on the anterior 1/3—2/3, brown to black on the remainder, with whitish orbits and a narrow yellow median stripe extending anteriorly from the apex of the triangle (Fig. 5). Vertical triangle and occiput entirely gray pollinose. Proboscis and clypeus shining black; face, cheeks, palpi, and antennae except the apex of the third segment, yellow. Antennae and aristae short and inconspicuous, the third segment suborbicular. Face short, the median carina sharp and prominent. Eyes large, short pubescent. Cheeks equal to about 2/3 the diameter of the third antennal segment and 1/5 the height of the eyes. Proboscis long, projecting beyond the head in resting position, the sections subequal in length, and each longer than the head. Bristles short and black, including a row along each side of the triangle, 6 pairs of fronto-orbitals, and 1 pair each of ocellars, inner and outer verticals, and long, convergent postverticals.

Thorax dark gray pollinose, the scutellum very dark. Mesonotum with shallow median and dorsocentral sulci; over these lines are located three brown pollinose stripes (Fig. 5), which are very distinct on the gray mesonotum except in rubbed specimens. Hairs short, predominantly black, arranged in rows, with three rows between the median stripe and each dorsocentral stripe. Thoracic bristles as in **quadrivittata.** Halteres with white knob and yellow pedicel.

Abdomen dark brown above, yellow ventrally, the narrow hind margins of the segments, and frequently the basal segment almost entirely, yellow.

Legs yellow, the mid and hind coxae, all femora except knees, and a median ring on the hind tibiae, black; apical segment of each tarsus browned; fore and mid tibiae rarely dusky on the outer surface near the base.

Wings similar to **quadrivittata** (Fig. 4). Veins pale yellow, the costa slightly darker. Second costal sector 1½—2 times as long as the third.

Type: ♂, Manhattan, Kansas, Oct. 3, 1930, (D. A. Wilbur) [Author's Colln.].

Allotype: ♀, Manhattan, Kansas, Oct. 24, 1930, (D. A. Wilbur).

Paratypes: **Kansas:** 1♂, 5♀, Manhattan, June 30, Aug. 13, Sept. 13, Oct. 1, 8, and 24, 1930, (D. A. Wilbur), sweeping pasture grasses; 1♂, 1♀, Manhattan, Oct. 17, 1933, (C. W. Sabrosky), swept from **Sporobolus asper**; 1♂, Manhattan, Sept. 17, 1933, (C. W. Sabrosky), on flowers of the Madeira Vine (**Boussingaultia**) [Kansas State College, and Author's Colln.]; 1♀, Douglas County, Oct. 11, 1933, (H. M. Smith); 1♂, Ottawa County, June 23, 1934, (C. W. Sabrosky); 1♂, 2♀, Pottawatomie County, Sept. 27, 1933, (C. W. Sabrosky) [Acad. Nat. Sci. Phila., and Author's Colln.]. **New Jersey:** 1♀, Corson's Inlet, July 26, 1923, (J. C. Bradley); 1♀, Warren Grove, July 24, 1923, (J. C. Bradley) [Cornell Univ. Colln.]. **New York:** 2♀, Babylon, Long Island, July 25 and Sept. 29, 1933, (F. S. Blanton); 8♂, 8♀, Babylon, Nov. 5, 1934, (F. S. Blanton) [F. S. B., and Author's Colln.]. **South Carolina:** 1♀, Batesburg, Aug. 24, 1930, (L. D. Tuthill) [Snow Colln.]. **Texas:** 1♂, College Station, April 1, 1930, (F. M. Hull) [Texas A & M Colln.].

In his study of the species of **Siphonella,** Adams (1904, p. 104) recorded one specimen from Colorado of a species with three brown vittae, which he identified and

included in his key as **Siphonella trilineata** (Meig.). Becker (1912, p. 95) pointed out, however, that the European species (recently placed by Duda in a new genus, **Aphanotrigonum**) had a short proboscis and did not belong in **Siphonella** at all, but in **Notonaulax** Beck., now called **Tricimba** Lioy. The North American species identified by Adams as **trilineata** was unknown to Becker.

The specimens recorded above are undoubtedly conspecific with the lone specimen seen by Adams. The character of three brown vittae, coupled with the elongate proboscis typical of **Madiza,** identifies this as a new species, probably the one which Adams called **trilineata** Meig. The author has a long series of the European **A. trilineatum** (Meig.), through the courtesy of Dr. Duda, and the species are very different. Superficially, Meigen's species resembles **quinquelineata** Adams.

Madiza submarginalis, new species.

Small, yellow species, resembling **Oscinella marginalis** (Mall.) in general appearance, with short, pale yellow stripes on the anterior half of the reddish-gray mesonotum, and short but distinct black pile. 1½ mm.

♂. Head yellow, only an ocellar spot, the upper margin of the third antennal segment faintly, the short pubescent arista, both portions of the proboscis, and the center of the occiput obscurely, brown to black. Front and antennae dark yellow; triangle very dark, almost a brown; cheeks whitish, equal in height to the diameter of the third antennal segment. Proboscis glossy black, the sections subequal in length, and each slightly shorter than the length of the head. Face slightly concave, the median carina sharp and prominent. Proportions of the front and triangle as in Fig. 7. Eyes with short, sparse pubescence. Bristles and hairs black and distinct, including 5-7 pairs of short fronto-orbitals, a row of short hairs along each side of the triangle, 15-20 irregularly arranged hairs on the anterior half of the front, and a short, black vibrissal hair. Ocellar and inner vertical bristles of medium length, but the convergent postverticals and divergent outer verticals are long and very evident.

Thorax yellow, subshining through the pale pollen. Disk of the mesonotum reddish-gray pollinose posteriorly, the color extending forward as narrow lines which leave the appearance of four short, pale yellow, elliptical vittae (Fig. 7). Scutellum pale yellow, except nar-

rowly at the base, much broader than long, with a blunt apex and the apical scutellars far apart. The usual thoracic bristles long, black, distinct; 1 pair of stout subapical and 1 pair of very long, convergent, apical scutellar bristles. Mesonotum and scutellum sparsely covered with short, black hairs. Metanotum orange. Pleura entirely yellow except for a shining black, elliptical spot on the anteroventral margin of the mesopleura. A faint dark spot on the pteropleura is obscured by pollen.

Abdomen: broad bands on the anterior portions of the fourth and fifth segments, the first three segments yellow.

Legs yellow, all femora slightly infuscated on their outer surfaces, the hind tibiae and all tarsi brown.

Wings as in Fig. 6; it is noteworthy that the third costal sector is distinctly longer than the second, due to the curvature of the second vein.

♀. Pteropleural spot slightly darker. All abdominal segments with broad brown bands anteriorly. Legs darker, especially the hind tibiae and tarsi.

Type: ♂, Manhattan, Kansas, June 12, 1934, (D. A. Wilbur), swept from blue grass [Author's Colln.].

Allotype: ♀, Columbus, Miss., July 16, 1930, (R. H. Beamer) [Snow Colln.].

Paratypes: 1♂, 2♀, Martin, S. Dak., July 7, 1924, (F. M. Hull), [S. Dak. State College Colln.].

Although the allotype and the paratypes were taken at localities far removed from that of the type, the similarity is so great for all details that the author has no hesitation in placing these specimens as conspecific.

Submarginalis is very close to **punctifrons** and **projecta,** and careful study will be required to distinguish it from the paler varieties of these species (see notes under **punctifrons**). Typical **punctifrons** may be separated at once, of course, by the unique feature of the shining black spot on the triangle below the ocelli; however, as noted under that species, occasional specimens seem to lack the spot, and other characters must be used. Specimens of **projecta** have not been seen, but the description indicates that it resembles **punctifrons** in the characters used here. Eliminating the extent and intensity of color of the mesonotal stripes and pleural spots, which seem to be quite variable, the following characters were found to be useful:

submarginalis n. sp.	punctifrons Bk., projecta Mall.
Hairs of head, mesonotum, and scutellum short and black; bristles black	Hairs slightly longer, pale yellow; bristles pale brown.
Scutellum short, blunt, much broader than long (2X)	Scutellum subtriangular, alas long as broad
1 pair, stout subapical scutellar bristles	2 pairs, weak subapical scutellar bristles
Apical scutellars set far apart	apical scutellars much closer, flanking the apex
2nd vein curved forward, third costal sector longer than 2nd sector, or at least subequal	2nd vein straight, 2nd costal decidedly longer than 3rd (1½—2 times)

Madiza punctifrons (Becker)

1912. **Siphonella punctifrons** Becker, Ann. Hist. Nat. Mus. Nat. Hung., 10 p. 101. [Utah, Idaho].

Since Becker's description may not be available for convenient comparison with my notes, the following translation is given here:

'Thorax and scutellum yellow; on the dorsum are three broad, dull, brown-gray longitudinal stripes, of which the median passes over onto the scutellum and there forms a large basal spot; on the disk there are then three dark lines, which correspond to the position of the three furrows in the genus **Notonaulax,** also the extreme margin of the dorsum is infuscated; pilosity white; humeral calli and lateral stripes remain yellow; pleura yellow with four black-brown spots. Head yellow; occiput black centrally; front yellow with a dull yellow, medium-sized ocellar triangle, in the middle of which below the ocellar tubercle is a shining black, circular spot equal in size to the ocellar tubercle. Antennae and palpi yellow, the former brown on the upper margin, third segment with yellow arista. Proboscis black, equal in length to the head; cheeks narrow. Abdomen yellow with three brown spots on the anterior margin of the four segments, of which those of the last three segments are joined together, yet the median spots especially appear triangular, but do not quite reach to the hind margin of the segment. Legs yellow; only on the hind femora and just on the apical halves, as well as on the basal halves of the hind tibiae, there are always corresponding brown spots. Wings hyaline with yellowish brown veins. 1½ mm. long.

'Two specimens from Cache County, Utah, and Lewiston, Idaho (Coll. Aldrich).'

From the examination of a series of specimens from widely scattered localities throughout the West, the author has concluded that this species is highly variable in the extent and intensity of color on the mesonotum, pleura, and abdomen.

Two females from the San Jacinto Mts. and Lemon Cove, Calif. [Snow Colln.], agree exactly with the description and undoubtedly represent the species. The three mesonotal stripes are so broad that the disk appears to be almost entirely reddish-gray, with three darker lines. The four spots on the pleura are at the usual places-lower margin of mesopleura, anteroventral corner of the pteropleura, sternopleura, and hypopleura. Abdominal segments 2 to 5 each have three large, black triangular spots, the apex of each barely failing to reach the hind margin of the segment. In the specimen from the San Jacinto Mts., the spots on the last three segments are connected at their bases, as Becker described, but in the other example, all spots are separate.

In contrast to these dark specimens, the Kansas material is very pale. The mesonotum is pale reddish-yellow, slightly darker in the positions where stripes usually occur, and with three narrow, black lines on the disk. The disk of the scutellum is only faintly darkened. On the pleura, the mesopleural spot is very distinct, but the other spots are faint, scarcely noticeable in some specimens; in one specimen from Manhattan, however, all spots are distinct. The abdominal spots are small, the apex of each spot barely or not at all exceeding the middle of the segment, and the resulting predominant color is pale yellow.

Such an extreme was at first believed to be a new species near **punctifrons,** but recent examination of specimens from Arizona and South Dakota showed that all intermediate stages are found, as well as various combinations of dark and light characteristics. In South Dakota specimens, for example, the mesonotal lines are very narrow, but the abdominal spots are large and the pleural spots are more distinct. In some Arizona specimens, on the other hand, the mesonotal stripes are broad and the pleural spots are very distinct, but the abdominal spots are small.

In the face of such intergradations and combinations, it is manifestly impossible to separate subspecific or varietal groups, and all specimens are therefore recorded as

M. punctifrons, regarded as a highly variable species with respect to color and color pattern. In addition to those outlined in the discussion under the preceding species, the best characters for recognition are the shining black spot on the triangle, the general mesonotal and abdominal pattern, and the yellow legs with the apposing brown spots on the apical halves of the hind femora and on the basal halves of the hind tibiae. See note under **projecta** also.

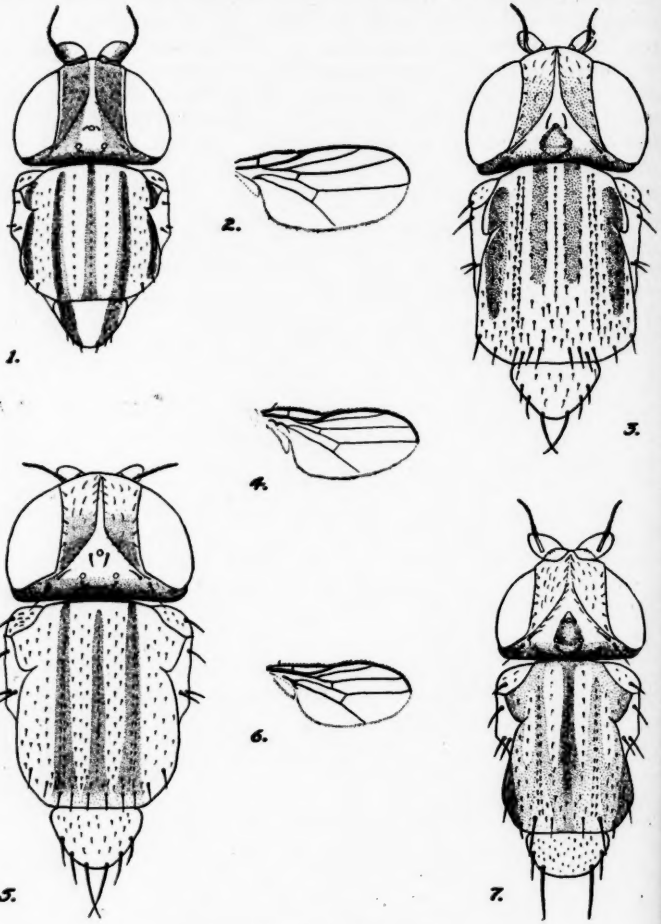
Distribution: **Arizona**: 1 ♀, Messa, July 28, 1927, (L. A. Anderson); 1 ♀, Patagonia, June 24, 1933, (R. H. Beamer); 2 ♀, Pima County, July 27, 1927, (P. A. Readio) [Snow Colln.]. **California:** 1 ♀, Lemon Cove, July 24, 1929, (R. H. Beamer); 1 ♀, San Jacinto Mts., July 21, 1929, (R. H. Beamer) [Snow Colln.]. **Kansas:** 1 ♂, McPherson County, June 30, 1934, (C. W. Sabrosky); 1 ♀, Ottawa County, June 24, 1934, (C. W. Sabrosky); 2 ♂, 2 ♀, Reno County, June 30, 1934, (C. W. Sabrosky); 1 ♂, 1 ♀, Manhattan, Riley County, Sept. 16, 1933, (C. W. Sabrosky), on flowers of the Madeira Vine (Boussingaultia) [Author's Colln.]. **Oregon:** 1, Nyssa, June 16, 1926, (R. W. Haegele) [Univ. of Idaho Colln.]. **South Dakota:** 1 ♀, Hot Springs, July 9, 1924, (F. M. Hull); 2 ♂, 2 ♀, Martin, July 7, 1924, (F. M. Hull) [S. Dak. State College Colln.]. Utah: 1 ♀, Zion National Park, Aug. 13, 1929, (R. H. Beamer) [Snow Colln.].

Madiza projecta Mall.

1913. Madiza projecta Malloch, Canad. Ent., 45, pp. 283-284 [N. Mex.].

The species was described from a series of six specimens from Las Cruces and Mesilla Park, New Mexico. The author has seen no specimens which might be referred to this species. On the basis of the descriptions, it can be separated from **punctifrons** (Beck.) only by the shining black spot on the triangle of the latter, absent in **projecta.** It is possible that **projecta** really represents a pale variant of **punctifrons,** in which the spot did not develop, but until the type has been studied in detail, the question of its status and relationship will be left open.

Two females from Martin, S. Dak. (same data as the series noted under **punctifrons**) agree in every detail with **punctifrons** except for the lack of the shining black spot on the triangle. On that basis, they would run to **projecta** in the key, but they may really be the former species, like the rest of the series from Martin, but lacking the spot for some reason.



Explanation of Plate

Figs. 1 and 2, **Madiza quinquelineata** (Adams); Figs. 3 and 4, **Madiza quadrivittata** n. sp.; Fig. 5, **Madiza trivittata** n. sp.; Figs. 6 and 7, **Madiza submarginalis,** n. sp.

Drawings 1, 3, 5, and 7 are of the head and thorax only.

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